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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/871,571

05/30/2001

Luc Deneire

IMEC210.001AUS

3491

20995

7590

12/21/2004

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EXAMINER

PHAN, MAN U

ART UNIT

PAPER NUMBER

2665

DATE MAILED: 12/21/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

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Office Action Summary	Application No.	Applicant(s)	
	09/871,571	DENEIRE ET AL.	
	Examiner	Art Unit	
	Man Phan	2665	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 May 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-50 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-4, 18, 19, 22-25, 31-33, 40-43 and 47-50 is/are rejected.
- 7) ☒ Claim(s) 5-17, 20, 21, 26-30, 34-38 and 44-46 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 May 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>10/11/01; 03/01/04</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. The application of Deneire et al. for a "Method and apparatus for channel estimation" filed 05/30/2001 has been examined. The preliminary amendment filed 10/01/01 has been entered and made of record. This application claims benefit from Provisional Application 60208447 filed 05/31/2000. Claims 1-50 are pending in the application.

Specification

2. Applicant is reminded of the proper language and format for an abstract of the disclosure.

The abstract should be in narrative form and generally limited to a single paragraph on a separate sheet within the range of 50 to 250 words. It is important that the abstract not exceed 250 words in length since the space provided for the abstract on the computer tape used by the printer is limited. The form and legal phraseology often used in patent claims, such as "means" and "said," should be avoided. The abstract should describe the disclosure sufficiently to assist readers in deciding whether there is a need for consulting the full patent text for details.

The language should be clear and concise and should not repeat information given in the title. It should avoid using phrases which can be implied, such as, "The disclosure concerns," "The disclosure defined by this invention," "The disclosure describes," etc.

The Abstract of the disclosure is objected to because it contains the legal phraseology "said". Correction is required.

3. The disclosure is objected to because of the following informalities:

The status of the related application USSN#09/505,228 noted on page 17, line 4, and USSN#09/613,181 noted on page 21 line 7, need to be updated. These applications are now US Patent # 6,760,300 and 6,591,284 respectively. Appropriate correction is required.

4. The specification is objected to as failing to comply with 37 CFR 1.74 because it fails to include reference numbers and detailed description of the invention shown for Figs. 1-2, 14. Any structural detail that is essential for a proper understanding of the disclosed invention should be shown in the drawing. MPEP ' 608.02(d). A proposed drawing correction or corrected drawings or amendment to the specification to add the reference sign(s) in the detailed description are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Objections

5. Claim 37, 39, 41, 43, 46 are objected to because of the following informalities:

The claim contains the phrase "capable of". It has been held that the recitation that an element is "capable of" perform a function is not a positive limitation but only requires the

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ability to so perform. It does not constitute a limitation in any patentable sense. In re Hutchison, 69 USPQ 138. Appropriate correction is required.

Claim Rejections - 35 USC ' 112

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1 and 22 recite limitation "the channel response" in line 2, and "the finiteness" in line 8.

Claim 7 recites limitation "the columns" in line 1, "the row" in line 2, "the non-zero time samples", "the impulse response" in line 4.

Claim 19 recites limitation "the column space" in line 3.

Claim 31 recites limitation "the channel response" in line 2, and "the finiteness" in line 9.

Claim 33 recites limitation "the channel response" in line 2, and "the finiteness" in line 6.

Claim 48 recites limitation "the channel response" in line 4, and "the finiteness" in line 5.

There is insufficient antecedent basis for these limitations in the claims.

Claim Rejections - 35 USC ' 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 1038 and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

9. Claims 1-4, 32, 22-25, 31, 33, 47 and 48-50 are rejected under 35 U.S.C. 103(a) as being unpatentable over H'mimy (US#5,912,876) in view of Mesiwala (US#6,097,776).

In so far, as understood with respect to claims 31, 33 and 47, H'mimy (US#5,912,876) and Mesiwala (US#6,097,776) disclose a novel system and method for estimating impulse responses of channels in OFDM systems, and detecting signals in the estimated channels, according to the essential features of the claims. The use of an iterative maximum likelihood (ML) estimation method and system to estimate the impulse response of a multipath fading channel and to detect a transmitted signal in OFDM and other multicarrier systems. H'mimy discloses a method for channel response estimation over a fast fading channel. A coded

orthogonal frequency division modulated (OFDM) signal that includes main and pilot signal portions is generated. The coded signal is transmitted over the fading channel to a receiving unit where the main signal is detected, and an estimation of the frequency response of the fading channel is made using the coded pilot signals. The detected main signal and the estimated channel frequency response are used to estimate the main signal. The determination can be based on a channel inversion of the frequency response or new channel estimation combined with maximum likelihood sub-sequence estimation. The maximum likelihood sub-sequence estimation in H'mimy is used for choosing the most likely transmitted data sequence (See Figs. 1&2; Col. 2, lines 7 plus and Col. M5, lines 56 plus).

However, H'mimy does not disclose expressly the channel estimation based on the reference or pilot tones. In the same field of endeavor, Mesiwala teaches a method of estimating the symbol time offset in a received signal of a data modem using only one received synchronization symbol. This estimate of the offset is used for a rapid synchronization during the starting phase or for resynchronization during a micro-interruption. The method estimates the offset by comparing the frequency domain constellation obtained by transforming the received synchronization symbol using the current sample pointer setting with the frequency domain constellations stored as templates. (A constellation point for a channel is phase and magnitude values in frequency domain for the channel). It chooses the template which is closest to the received constellation and declares the offset corresponding to the chosen template as the estimated offset for the received symbol. The templates are obtained by the following process. First, a time domain signal is obtained by transforming a fixed (transmitted) synchronization symbol comprising of several channels each with a

constellation point specified for the channel. Next, the time domain signal is shifted by k samples and transformed into a frequency domain constellation. The frequency domain constellation serves as the template for offset value k . The shifting of the time domain signal by other values of k and obtaining the corresponding frequency domain constellations result in the set of required templates (Fig. 7; Col. 3, lines 27 plus). It's noted that in the prior art of OFDM communications, a "channel response estimate" is a frequency-domain estimate of the channel response for a particular subband of a communication channel between the transmitter and the receiver. (The communication channel may include a number of propagation paths). Channel gain estimates may be processed and transformed to obtain channel response estimates. A "channel estimate" can generically refer to a channel gain estimate, a channel response estimate, or some other type of estimate for the communication channel.

Regarding claims 1-4, 32 and 22-25, they are method claims corresponding to the apparatus claims 31 and 33, 47 above. Therefore, claims 1-4, 32 and 22-25 are analyzed and rejected as previously discussed with respect to claims 31, 33, 47.

Regarding claims 48-50, they are system claims corresponding to the method and apparatus claims above. Therefore, claims 48-50 are analyzed and rejected as previously discussed with respect to claims 31, 33, 47.

One skilled in the art would have recognized the need for effectively and efficiently synchronizing frequency signals in an OFDM communication system utilizing maximum likelihood estimation, and would have applied Mesiwala's method for estimating time offset of a synchronization symbol in a received signal of data modem into H'mimy's novel use of

channel response estimation over a fast fading channel. Therefore, It would have been obvious to a person of ordinary skill in the art at the time of the invention was made to apply Mesiwala's maximum likelihood estimation of symbol offset into H'mimy's method and apparatus for channel estimation with the motivation being to provide a maximum-likelihood estimate of the frequency response of channel.

10. Claims 18, 19, 40-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over H'mimy (US#5,912,876) in view of Mesiwala (US#6,097,776) as applied to the claims above, and further in view of Jones, IV et al. (US#6,487,253).

In so far, as understood with respect to claims 40-43, H'mimy and Mesiwala disclose the claimed limitations as discussed in the paragraph 9 above. However, the claims further require the use of IFFT matrix and weighting matrix with reference tones in obtaining maximum likelihood frequency domain estimate. In the same field of endeavor, Jones, IV et al. discloses systems and methods for estimating the response of a channel between two nodes of a digital communication network, in which interference and/or noise present on received training symbols is estimated. Based on the measured noise and/or interference, a weighting among training symbols is developed. Channel response is then estimated based on a weighted least squares procedure. Jones, IV et al. teaches in Figs. 4 & 5 the flowcharts describing steps of the operation of channel estimation processor 110 as depicted in Fig. 3, and detailed steps of estimating channel response. The estimation of noise and interference assumes that channel response will change slowly relative to OFDM burst rate and that therefore successive channel response values for each frequency domain symbol position will

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be highly correlated. Once the noise and/or interference for each training symbol has been estimated by time averaging, a weighting among the training symbols is determined based on the measured noise and/or measured interference at step 404. The weighting is such that training symbols experiencing greater corruption by interference and/or noise will have less influence in determining the channel response estimate. The weighting may be characterized by a matrix R having dimensions v by v (Col. 4, lines 1 plus).

Regarding claims 18, 19, they are method claims corresponding to the apparatus claims 40-43 above. Therefore, claims 18, 19 are analyzed and rejected as previously discussed with respect to claims 40-43.

One skilled in the art would have recognized the need for effectively and efficiently synchronizing frequency signals in an OFDM communication system utilizing maximum likelihood estimation, and would have applied Jones, IV's determine channel impulse response based on weighted least mean square procedure and Mesiwala's method for estimating time offset of a synchronization symbol in a received signal of data modem into H'mimy's novel use of channel response estimation over a fast fading channel. Therefore, It would have been obvious to a person of ordinary skill in the art at the time of the invention was made to apply Jones, IV's OFDM channel estimation in the presence of interference, and Mesiwala's maximum likelihood estimation of symbol offset into H'mimy's method and apparatus for channel estimation with the motivation being to provide a maximum-likelihood estimate of the frequency response of channel.

Allowable Subject Matter

11. Claims 5, 20, 26, 34 and 44 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is an examiner's statement of reasons for the indication of allowable subject matter: The closest prior art of record fails to disclose or suggest wherein the determining of maximum likelihood frequency domain estimate comprises transforming the reference tones in time domain measurements, determining from the time measurements maximum likelihood time domain estimates, and transforming the maximum likelihood time domain estimates in frequency domain for obtaining the maximum likelihood frequency domain estimate, as specifically recited in claims 5, 26, 34. determining an intermediate result by multiplying a partial weighted N_h by N_u IFFT matrix with the reference tones with N_h the length of finite time response, and multiplying the intermediate result with a partial weighted N_f by N_h FFT matrix, to thereby obtain the maximum likelihood frequency domain estimates as specifically recited in claims 20, 44.

Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The Eberle et al. (US#6,760,300) is cited to show the high speed wireless OFDM transceiver modem.

The Brockmeyer et al. (US#6,591,284) is cited to show the method for performing a fast transform.

The Lashkarian (US#6,678,339) is cited to show the global optimum maximum likelihood estimation of joint carrier frequency offset and symbol timing error in multi-carrier systems.

The Heinonen et al. (US#6,768,714) is cited to show the methods and apparatus for use in obtaining frequency synchronization in an OFDM communication system.

The Heiskala (US#6,298,035) is cited to show the estimation of two propagation channels in OFDM.

The Thomas et al. (US#6,826,240) is cited to show the method and device for multi-user channel estimation.

The Ramesh (US#5,905,743) is cited to show the apparatus, methods and computer program products for sequential maximum likelihood estimating communications signals using whitening path metrics.

The Ariyavisitakul et al. (US#6,473,393) is cited to show the channel estimation for OFDM systems with transmitter diversity.

The Li et al. (US#6,795,392) is cited to show the clustered OFDM channel estimation.

The Kane et al. (US#5,355,431) is cited to show the signal detection apparatus including maximum likelihood estimation and noise suppression.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to M. Phan whose telephone number is (571) 272-3149.

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The examiner can normally be reached on Mon - Fri from 6:00 to 3:00 EST. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Huy Vu, can be reached on (571) 272-3155. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (571) 272-2600.

14. Any response to this action should be mailed to:

Commissioner of Patents and Trademarks

Washington, D.C. 20231

or faxed to: (703) 305-9051, (for formal communications intended for entry)

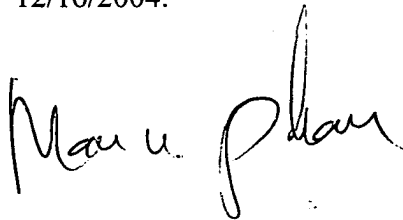
Or: (703) 305-3988 (for informal or draft communications, please label

"PROPOSED" or "DRAFT")

Hand-delivered responses should be brought to Crystal Park II, 2021 Crystal Drive, Arlington, VA., Sixth Floor (Receptionist).

Mphan

12/16/2004.

A handwritten signature in black ink, appearing to read 'Man U. Phan', written in a cursive style.

MAN U. PHAN
PRIMARY EXAMINER